

Owner's Guide

HP SureStore E Disk Array XP512  
HP SureStore E Disk Array XP48

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## Notice

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## Safety notices

Any servicing, adjustment, maintenance, or repair must be performed only by authorized service-trained personnel.

**Caution** Denotes a hazard that can cause hardware or software damage.

**WARNING** Denotes a hazard that can cause personal injury or death.

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## Format conventions

<b>literal</b>	Specifies text to be typed exactly as shown, such as commands, path names, file names, and directory names.
<i>variable</i>	Indicates that you must supply a value.
output	Denotes text displayed on the screen.
[ ]	Indicates that the enclosed element is optional and may be left out.
{ }	Indicates that you must specify one of the listed options.
	Separates alternatives.
...	Indicates a repetition of the preceding parameter.

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## Revision History

June 1, 2000	Original release for the HP SureStore E Disk Array XP512
November 7, 2000	Addition of the HP SureStore E Disk Array XP48

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## Updates

For the most current information about HP SureStore E XP products, visit the support web sites at:

**[www.hp.com/support/xp256](http://www.hp.com/support/xp256)**

**[www.hp.com/support/xp512](http://www.hp.com/support/xp512)**

**[www.hp.com/support/xp48](http://www.hp.com/support/xp48)**

For information about product availability, configuration, and connectivity, consult your HP account representative.



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# ABOUT THE HP SURESTORE E DISK ARRAY XP512 AND XP48

Your new disk array is a refinement of the successful HP SureStore E Disk Array XP256 from HP. It provides reliable and secure data protection featuring redundant circuitry and RAID storage options for data security. The disk array also supports multiple operating systems, platforms, and RAID groups. The advantages include:

- continuous data availability
- nondisruptive service and upgrades
- connectivity
- scalability
- data integrity

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## Continuous Data Availability

The XP family of disk arrays are the first RAID disk arrays to provide truly continuous data availability. They are designed for nonstop operation and continuous access to all user data.

HP XP512 and XP48 disk arrays have no single point of component failure, which enables uninterrupted access to data.

The disk array has component and function redundancy, providing full fault tolerance for disk array microprocessors, control storage, control and data buses, power supplies, and cooling fans. The disk array can sustain multiple component failures and still continue to provide full access to your stored data.

While access to your data is never compromised, the failure of a key component can cause a temporary reduction in disk array performance.

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## Nondisruptive Service and Upgrades

Monitoring software detects failed disk drives or internal hardware and notifies the HP Stress Free Central support center automatically so an HP service representative can replace the faulty hardware. There is no need to be concerned with user serviceable components. Only an HP Service Representative should open the cabinets.

All hardware subassemblies can be removed, serviced, repaired, or replaced nondisruptively during disk array operation. All microcode upgrades can be performed during normal disk array operations, using your disk array's built-in service processor (SVP) or the facilities of the host. Alternate paths can be set by host failover software or alternate Fibre Channel paths.

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## Connectivity

To connect the XP512 or the XP48 disk array to a host system, these two types of connections are available:

- Fibre Channel
- ESCON (Enterprise System Connection)

### Fibre Channel Connectivity

#### XP512

The XP512 supports a maximum of four pairs of channel adapters that can support up to 32 Fibre Channel ports. Each port is assigned a unique target ID (TID) and can support 256 logical units (LUs). Your disk array can support up to 8,192 LUNs attached through the Fibre Channel, which provides data transfer rates up to 100 MB/sec. The disk array can support Fibre Channel arbitrated loop (FC-AL) and Fabric Fibre Channel topologies.

#### XP48

The XP48 supports a maximum of three pairs of channel adapters that can support up to 24 Fibre Channel ports. Each port is assigned a unique TID and can support 256 LUs. Your disk array can support up to 6,144 LUNs attached through the Fibre Channel, which provides data transfer rates up to 100 MB/sec. The disk array can support FC-AL and Fabric Fibre Channel topologies.

## ESCON Connectivity

### **XP512**

The XP512 supports a maximum of four pairs of channel adapters that can support 32 ESCON ports.

### **XP48**

The XP48 supports a maximum of three pairs of channel adapters that can support 24 ESCON ports.

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## Data Integrity

The highest levels of data integrity are provided by HP disk arrays. This is accomplished by using RAID technologies, along with redundant hardware throughout your disk array. Refer to the Appendix for more information about RAID technology. Below is a list of the hardware features that allow the XP512 and XP48 to achieve their high availability and data integrity:

- RAID0/1, RAID5
- mirrored write cache
- dual channel adapters (CHAs) and array control processors (ACPs)
- dual and concurrently active data and control paths through the disk array
- split power domains on internal data paths
- hot-pluggable boards
- hot-pluggable fans, power supplies, and controllers
- upgradable online firmware

Following are some of the software features/products that complement your disk array hardware to ensure that the array meets your requirements for high reliability:

- HP SureStore E support
  - “Phone Home” capability to multidisciplinary “Stress-Free” Center
  - advanced remote diagnostics
  - full-solution (Host-SAN-Storage) support

- Full software and solution integration
  - local and remote mirroring for online backup and disaster recovery (HP SureStore E Business Copy XP and Continuous Access XP)
  - security for multiple-serve consolidation (HP SureStore E Secure Manager XP)
  - zero downtime backup (HP OmniBack, Exchange, Oracle, or SAP)
  - centralized resource management (HP SureStore E SAN Manager LM/DM, Performance Manager XP, Performance Advisor XP, and Auto LUN XP)
  - easy to use interface to access your disk array resources (HP SureStore E Remote Control XP)
- I/O path failover and load balancing (HP SureStore E AutoPath XP)

To obtain updates to the software, go to the following websites:

**[www.hp.com/support/xp512](http://www.hp.com/support/xp512)**

**[www.hp.com/support/xp48](http://www.hp.com/support/xp48)**

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# Comparing the XP512 to the XP48

The XP512 and the XP48 are members of the same product family. The main differences are in configuration capacities. Except as limited by the configuration limitations, the XP512 and XP48 provide identical functionality.

There are some additional differences. For example, the XP48 ACP is an integral part of the XP48 and cannot be removed or interchanged. The following table describes the differences between the XP512 and XP48 disk arrays.

Table 1. Comparing the XP512 to the XP48

Feature	XP512	XP48
Power	Single-phase or 3-phase	Single-phase only
DKC/DKU	One DKC Up to 6 DKUs	Single cabinet unit only (no expansion)
Maximum hard disk drives	512	48
Maximum spare disk drives	16	4
Maximum parity groups/subsystem	126	11
Maximum disk drive capacity	37 TB	3.5 TB
Maximum cache	32 GB	16 GB
Cache expansion board	Yes	No

(continued)



Table 1. Comparing the XP512 to the XP48 (continued)

Feature	XP512	XP48
Available hard disk drives	73GB 10K rpm Fibre Channel disk drive	73GB 10K rpm Fibre Channel disk drive
	47GB 10K rpm Fibre Channel disk drive	18 GB 10K rpm Fibre Channel disk drive
	18 GB 10K rpm Fibre Channel disk drive	
Max shared memory	1.28GB	1.0GB
ACP pairs	4	1
CHIP pairs	4	3
Configuration disk	XP512-specific	XP48-specific
SVP code	XP512-specific	XP48-specific
RAID level	RAID 0/1 (3D + 1P) RAID 5 (2D + 2D)	RAID 0/1 (3D + 1P) RAID 5 (2D + 2D)
Maximum LDEV #	4096	4096
Available LUNs	8192	6144
Maximum LU #/port	256	256

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## Websites

For the most current information about the XP family of disk arrays, visit these websites:

**[www.hp.com/support/xp256](http://www.hp.com/support/xp256)**

**[www.hp.com/support/xp512](http://www.hp.com/support/xp512)**

**[www.hp.com/support/xp48](http://www.hp.com/support/xp48)**

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## **THE HP SURESTORE E DISK ARRAY XP512 HARDWARE**

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## General Safety Guidelines

Read the following safety guidelines carefully and follow them when you work with your XP512 disk array.

- Remember that the maintenance of your machine must be done only by trained and qualified HP field engineers. Only an HP Service Representative can power off the disk array.
- Please read and follow the safety guidelines and procedures in this manual and any of your related manuals.
- In this manual and on the machine, hazard warnings are provided to aid you in preventing or reducing the risk of death, personal injury, or product damage. Understand and follow these hazard warnings fully.
- The hazard warnings that appear on the warning labels on the machine or in the manual have one of the following alert headings consisting of an alert symbol and a signal word, “**Warning**” or “**Caution**”:



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### Warning

This indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

The alert symbol shown left precedes every signal word for hazard warnings and appears in safety-related descriptions in the manual.

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### Caution

*This indicates a hazardous situation which, if not avoided, will or can result in serious damage of product or loss of data.*

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- The signal word “NOTICE” is used to present warnings that are not directly related to personal injury hazards.
- When warning labels become dirty or start peeling off, replace them.

- If any physical accident such as abnormal noise, smell, or smoke occurs on the disk subsystem while running, immediately power off the disk subsystem by pulling the UNIT EMERGENCY POWER OFF switch on the disk subsystem.
- Do not power off the system unless it is a UNIT EMERGENCY POWER OFF situation.
- Keep the front and rear doors closed at all times.
- Keep the tops and sides of the cabinets clear to allow air to flow properly.
- Do not perform any procedures not described in this document. If you have any questions or concerns, please contact your HP Service Representative.



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## Warning

Do not touch areas marked HAZARDOUS, even with the power off. These areas contain high-voltage power.

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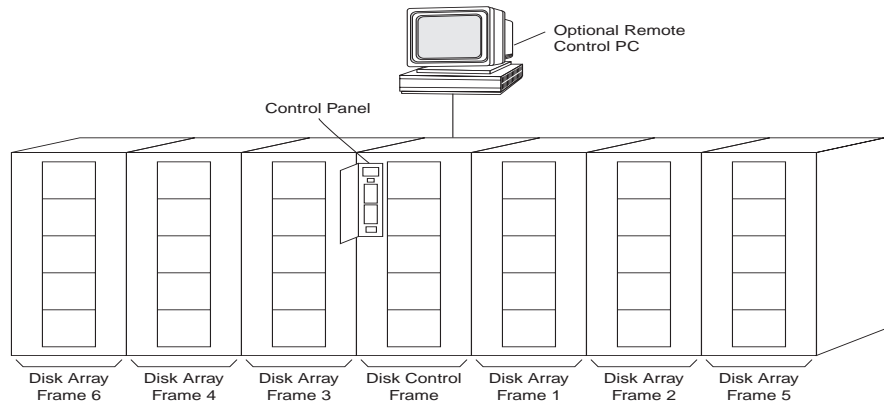
Keep in mind that the hazard warnings in this manual or on the machine cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand.

Be alert and use your common sense. If you have any questions, contact your HP Service Representative.

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## Physical Components

Your HP SureStore E Disk Array XP512 is a high-performance RAID-capable disk array system. It is used to store large quantities of data in an efficient and secure manner.



*Figure 1. HP SureStore E Disk Array XP512*

Your disk array has the following major hardware components:

- One disk control frame

The single disk control frame cabinet contains the control panel, connection hardware, the service processor, and control boards for the disk arrays.

- One to six disk array frames

The disk array frame cabinets contain your disk drives. You can connect up to six disk array frames to your HP SureStore E Disk Array XP512.

- One service processor (SVP)

The SVP is an internally mounted laptop computer used for maintenance. The SVP is located in the disk control frame cabinet. The SVP is used by your HP Service Representative only.

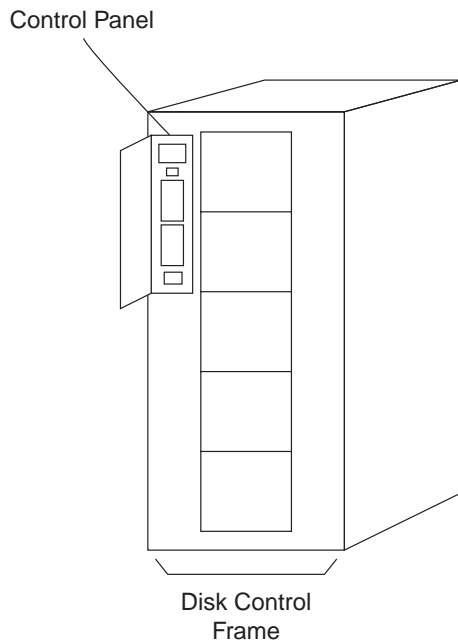
- (*Optional*) one remote console PC

The remote console PC is attached to your disk array by an internal local area network (LAN). The remote console PC runs applications that allow you to monitor and manage the disk array operations.

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## Disk Control Frame

The disk control frame controls your disk array. It provides you with a control panel, power supplies, controller boards, and your service processor.



*Figure 2. Disk Control Frame*

There is no single point of failure in the disk array. It is designed with redundant controllers and redundant power supplies, all of which can be removed or replaced without interrupting access to your data. Only your HP Service Representative can remove or replace hardware.

## Control Panel

The control panel is your view to the disk array. Once the disk array is powered on and running normally, there are no user operations required at the control panel. The control panel will be discussed in further detail later in this chapter.



## Service Processor

The service processor (SVP) is a built-in PC connected inside the disk control frame. The SVP gives your HP Service Representative a method to access the software system on the disk array.

Your HP Service Representative uses the SVP to configure, maintain, and upgrade your disk array software and hardware. The service processor also collects performance data on the disk array for diagnostic testing and analysis.

To protect the user's security, the SVP does not have access to any user data stored on the disk array.

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## Disk Array Frames

The disk array frames are where your physical disk drives, the disk groups, and any dynamic spare disk drives are located. You must have at least one disk array frame to operate the system, and you may have up to a maximum of six disk array frames installed on your system. If you have six disk array frames that are fully populated with disk drives, you will have a maximum of up to 37 TB.

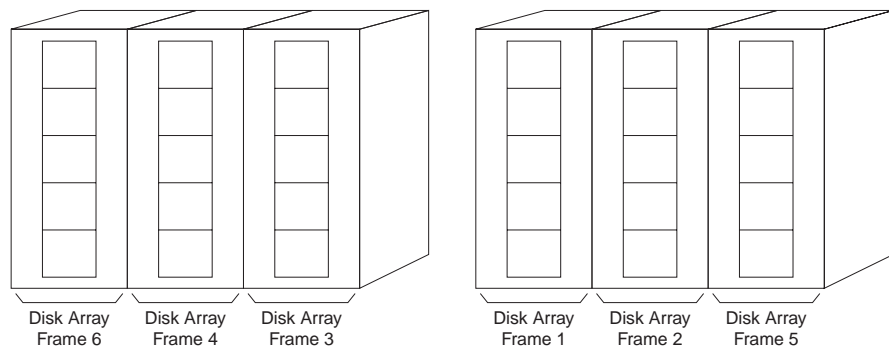
## Available Disk Drives

Your disk array uses 3.5-inch disk drives, and a variety of disk capacities are available. Ask your HP Service Representative about currently available disk drives. Any of the disk drives in your disk array frames can be replaced without disrupting user activity. The disk array automatically detects and corrects disk errors.

## RAID Options

Any of your spare disk drives can back up any other disk drive of the same capacity, in any disk array, even if the failed disk and the spare disk are in different array domains, whether you are using RAID0/1 or RAID5 array groups.

Your disk arrays can be configured with a minimum of one and a maximum of 16 spare disk drives. See figure 3 (page 27).



*Figure 3. Disk Array Frames*

## **Remote Console PC (optional)**

The remote console PC is for user access to the system software. Your remote console PC runs a main remote control application and other standard and optional software to manage and monitor the disk array.

Your remote console PC can be connected to up to eight disk arrays, using a special LAN connection. See figure 4 (page 28).

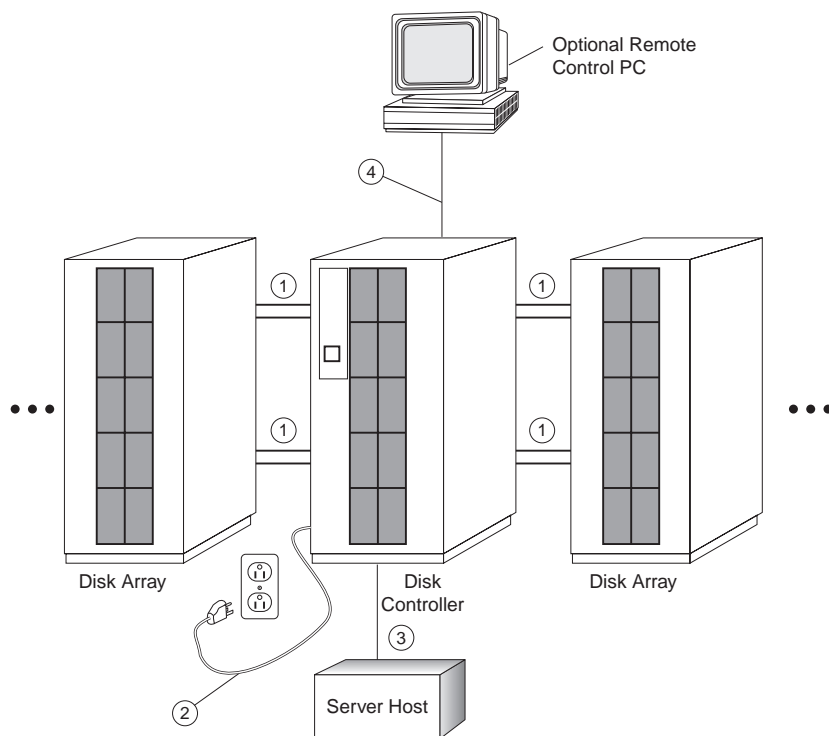


Figure 4. XP512 Disk Array

Connections to the XP512 disk array include:

Table 2. XP512 Disk Array Connections

Callout in Figure 4 (page 28)	Connecting	Type
1	A DKC to a DKU; a DKU to another DKU	Fibre Channel
2	The DKC to external power	Power cable
3	The DKC to the host server	Fibre Channel ESCON
4	DKC to the Remote Console	LAN

The specific hardware requirements for your remote console PC, such as the required processor speed, storage capacity, and memory, will vary depending on the optional software that you use and the number of disk array frames you have connected to the system.

To protect your user's security, the RC software for the remote console PC does not have access to any user data stored on the disk array.

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## Control Panel

Figure 5 (page 31) and table 3 (page 32) show the control panel and its functions, respectively.

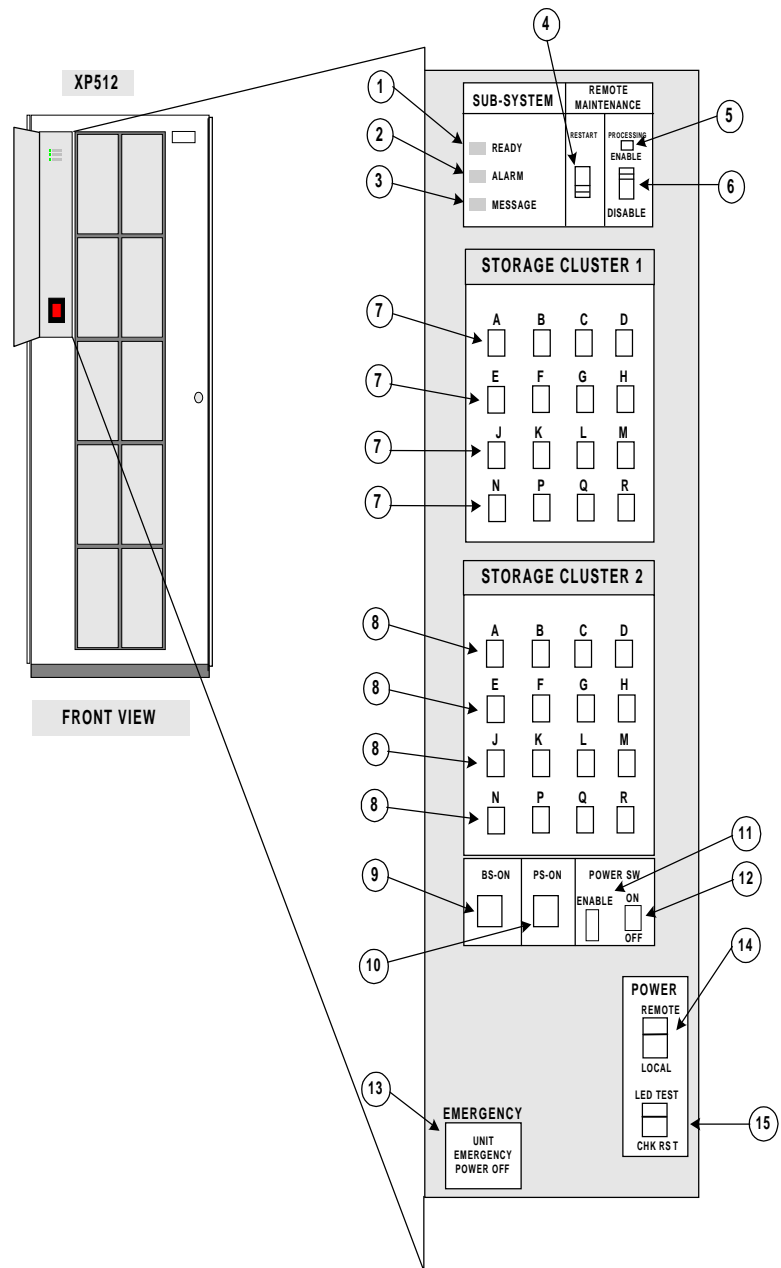


Figure 5. Control Panel

Table 3. Part Function on Control Panel

Item	Label	Indicator	Description
1	SUBSYSTEM READY	LED (Green)	Indicates that input/output operation on the channel interface is enabled. If the LED is off, the system is not accepting data.
2	SUBSYSTEM ALARM	LED (Red)	Indicates DC under voltage, DC over current, abnormally high temperature, or an unrecoverable failure has occurred. Expect a call from your HP Service Representative.
3	SUBSYSTEM MESSAGE	LED (Amber)	Indicates that any message has been issued from Clusters. Phone Home paging is enabled and your HP Service Representative has been notified.
4	SUBSYSTEM RESTART	Switch	Used to unfence the fenced drive path and to release Write Inhibit. There is a blocked path somewhere between a host and a disk drive. By restarting the subsystem, a soft reset will be performed to try to recover. If system restart does not unblock the path, an HP Service Representative will be notified.
5	REMOTE MAINTENANCE PROCESSING	LED (Amber)	Indicates that remote maintenance is being processed. An HP Service Representative is probably working on your system, but the system is online and accepting data.
6	REMOTE MAINTENANCE ENABLE/DISABLE	Switch	Used to permit remote service maintenance. Disable: No one can provide maintenance Enable: HP Service Representative can provide maintenance.

(continued)



Table 3. Part Function on Control Panel (continued)

Item	Label	Indicator	Description
7	STORAGE CLUSTER 1  CHANNEL A-R ENABLE	LED (Green)	Serial Channel/Fibre Channel:  (1) On: Indicates some of the logical paths are established.  (2) Fast blinking: Indicates that the corresponding channel route is executing the channel command. (Only Serial Channel)  (3) Slow blinking: Indicates none of the logical paths are established.  (4) Off: Indicates that the corresponding channel route is not enabled.
8	STORAGE CLUSTER 2  CHANNEL A-R ENABLE	LED (Green)	Serial Channel/Fibre Channel:  (1) On: Indicates some of the logical paths are established.  (2) Fast blinking: Indicates that the corresponding channel route is executing the channel command. (Only Serial Channel)  (3) Slow blinking: Indicates none of the logical paths are established.  (4) Off: Indicates that the corresponding channel route is not enabled.

(continued)

Table 3. Part Function on Control Panel (continued)

Item	Label	Indicator	Description
9	BS ON	LED (Yellow)	<p>When the LED is on, unit is plugged in and receiving power from the primary AC outlet. The SVP is receiving power from the outlet.</p> <p>If BS is off, then the disk array is not receiving power from the primary AC outlet. Check the electrical outlets in your building.</p>
10	PS ON	LED (Green)	<p>When the LED is on, the power switch is on, and the array is ready to receive data.</p> <p>Off means the power switch is off; the disk array is not powered on and is not ready to receive data.</p>
11	PWR SW ENABLE	Switch	Used to enable the PWR on/off switch. To enable the PWR on/off switch, turn the PWR SW ENABLE switch to the ENABLE position.
12	PWR ON/PWR OFF	Switch	To switch on/off the subsystem, use this switch while turning the PWR SW ENABLE switch to the ENABLE position. This switch is valid when the REMOTE/LOCAL switch is set to the LOCAL position.
13	UNIT EMERGENCY POWER OFF	Switch	Used to power off the storage subsystem in an emergency situation.
14	PWR ON/PWR OFF REMOTE/LOCAL	Switch	<p>Determines how the disk array is powered on or off.</p> <p>REMOTE: Disk array is powered on/off by the instructions of the CPU.</p> <p>LOCAL: Disk array is powered on/off by the PWR ON/PWR OFF switch.</p>
15	LED TEST/CHK RESET	Switch	<p>LED TEST position: The LEDs on the panel go on.</p> <p>CHK RESET position: The PS and THERMOCOUPLE alarms are reset.</p>

---

## UNIT EMERGENCY POWER OFF

A switch is provided on the control panel on the front side of the disk control frame (DKC) for an emergency powering off.

If you encounter any abnormality such as an abnormal sound, smell, or smoke, power off the disk subsystem by operating the UNIT EMERGENCY POWER OFF switch following the procedure below. The procedure for operating the switch is as follows:

1. Push the control panel cover at the portion where PUSH is marked, open the control panel cover, then operate the UNIT EMERGENCY POWER OFF switch.
2. In using a UNIT EMERGENCY POWER OFF switch, first pull it up and then pull it toward you as illustrated in figure 6 (page 36).

---

**Caution** *Pulling a UNIT EMERGENCY POWER OFF switch on the disk controller instantly shuts down the storage subsystem, neglecting the system's power-off sequence. Jobs in process are aborted, and their integrity after recovery is not guaranteed. Therefore, this method should be used only in an emergency and not in usual maintenance.*

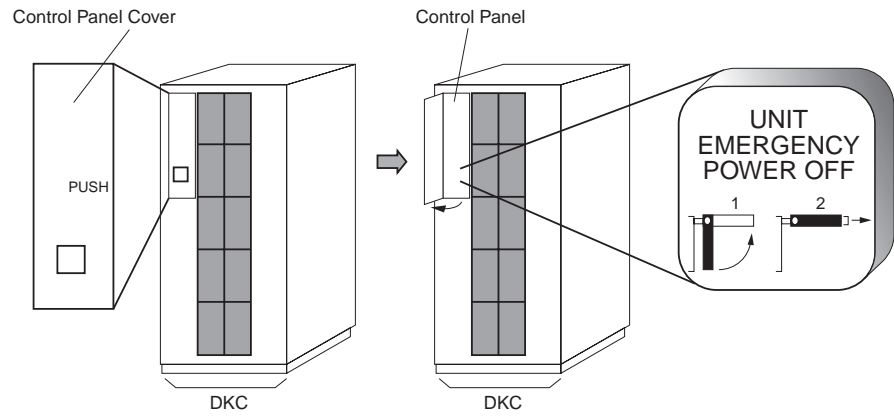
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**Caution** *The UNIT EMERGENCY POWER OFF switch on the disk controller provides only partial power-off capability. AC input power remains present at the primary circuit. Therefore, do not use the switches on these units unless you need to power off the unit as an emergency measure.*

---

When pulled, a UNIT EMERGENCY POWER OFF switch locks itself to prevent further powering on and requires a trained and qualified HP field engineer for recovery.



*Figure 6. Pulling the UNIT EMERGENCY POWER OFF Switch*

---

## Normal Operations

The disk array does not require intervention from the user. The disk array reports any remote error messages (R-SIMs) to your remote console PC and also sends the report to the HP Service Center automatically.

The RC software allows the HP Service Representative to view the R-SIMs by date and time or by controller and to manage the R-SIM log file on the remote console PC. For more information on SIMs, see “Troubleshooting” (page 77).

---

## Powering Off the Disk Array

Situations may arise in the operation of the disk array that require the user to power off the disk array. These situations include:

- UNIT EMERGENCY POWER OFF
- Planned power-off

### UNIT EMERGENCY POWER OFF

An emergency is a critical situation such as a physical plant catastrophe such as a flood, hurricane, tornado, or a threat of injury or death to a person. In an emergency, the critical need is to quickly remove power from the disk array. A quick restart is not necessary.

In an emergency, the operator should trip the UNIT EMERGENCY POWER OFF switch. The UNIT EMERGENCY POWER OFF switch is located on the control panel.

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**Caution** *Use this switch only in case of an emergency. An HP Service Representative is required to reset the UNIT EMERGENCY POWER OFF and to power on the disk array.*

---

#### To power off the disk array in an emergency:

1. Open the control panel cover by pushing on the point marked **PUSH**.
2. Pull the UNIT EMERGENCY POWER OFF switch, figure 6 (page 36), up and then out toward you as illustrated on the switch.
3. Call the HP support center. The UNIT EMERGENCY POWER OFF switch must be reset by an HP Service Representative before the disk array can be powered on again.

## Planned Power-Off

There may be times when a site power outage is planned. These situations would include alterations to the data center, inspections, or work by the electric company. If a scheduled power outage affects an HP SureStore E Disk Array XP512, the power-off of the disk array must be scheduled with a trained HP support representative.

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**Caution** *Only a trained HP representative can shut down and power off a disk array. Shutting down and powering off a disk array is not a customer activity. A user should not attempt to power off the disk array at any time other than an emergency.*

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When planning for your planned power outage, please contact your HP customer engineer (CE) to schedule a customer visit.

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## Recovering from a Power Outage to the Disk Array

A power outage to the array is when the primary building power is lost due to electrical blackouts, thunderstorm activity, etc., and input AC power is not received by the array. The disk array will maintain its state and recover when power is restored. The array cache is backed up by batteries that will maintain its state for a minimum of 48 hours. This length of time will provide coverage for most outages. In cases where the outage will extend beyond 48 hours, the batteries can be replaced by an HP CE, which will extend the time, if necessary.

---

**Caution** *After power is restored to the customer site and before restoring power to the disk array, HP recommends verification of power by an electrician to ensure all phases are restored and input power to the disk is stable.*

---

The user may opt to call a trained HP representative to recover from the disk array power failure. The user may also use the following procedures for disk array power-failure recovery:

1. Move the REMOTE/LOCAL switch on the front panel (14, figure 5 (page 31)) to the LOCAL position. The normal position is REMOTE.
2. Hold down the ENABLE switch while toggling the PWR ON/OFF switch to the PWR ON position (11/12, figure 5 (page 31)).
3. The following LED power sequence will occur:

The BS-ON (9, figure 5 (page 31)) will turn amber and the PS ON LED (10, figure 5 (page 31)) will turn green.

The CHANNEL LED (7, figure 5 (page 31)) will light green for every adapter installed.

The MESSAGE LED (3, figure 5 (page 31)) will turn amber signifying a SIM was generated (because the disk array went down unexpectedly).

Finally, the Ready LED (1, figure 5 (page 31)) will light green signifying the system is ready.



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**Caution** *Powering on the disk array may take upwards of 10 minutes, depending on the number of disks installed in your disk array. Power-on is complete only when the READY LED turns green.*

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4. Move the REMOTE/LOCAL switch on the front panel (14, figure 5 (page 31)) to the REMOTE position.

---

# Specifications

Some of the XP512 disk array specifications are listed in this section. Refer to the HP SureStore E Disk Array 48 Site Prep Guide in the XP48 [www.hp.com/support/xp512](http://www.hp.com/support/xp512) for a complete set of XP512 specifications.

## Temperature

Table 4. Temperature Specifications

Temperature Specifications (Degrees F = 1.8 x Degrees C + 32)	
Nonoperating/storage temperature range	–10° to +43°C
Operating temperature	+16° to +32°C
Recommended operating temperature range	+21° to +24°C
Shipping and storage temperature	–25° to +60° C
Temperature shock immunity—maximum rate of change	+10°C per hour
Over-temperature shutdown	Shutdown at +60°C

## Humidity

Table 5. Humidity Specifications

Humidity Specifications	
Nonoperating/storage humidity range	5% to 95% RH
Operating humidity range at 22°C	20% to 80% RH
Recommended operating humidity range at 22°C	50% to 55% RH
Nonoperating humidity range	8% to 90%
Procedure for recovery from moisture condensation	None

## Mechanical Vibration

Maximum operating  
acceleration

0.05G at a frequency range of 10 to 300 Hz

## AC Line Voltage

The following tables detail the AC line voltage.

*Table 6. 1-Phase 60 Hz Operation*

Specification	60 Hz-V1	60 Hz-V2s	60 Hz-V3
Nominal rated voltage (vac)	200	208	230
Minimum operating voltage (vac)	184	191	212
Maximum operating voltage (vac)	212	220	244
Rated line current—DKU (arms)	12.3	11.9	10.6
Rated line current—DKC (arms)	5.7	5.6	5.2
Dropout carry-through time at minimum line voltage (ms)	500	500	500

*Table 7. 1-Phase 50 Hz Operation*

Specification	50 Hz-V1	50 Hz-V2s	50 Hz-V3	50 Hz-V4
Nominal rated voltage (vac)	200	220	230	240
Minimum operating voltage (vac)	184	202	212	221
Maximum operating voltage (vac)	212	233	244	254
Rated line current—DKU (arms)	12.3	11.1	10.8	10.8
Rated line current—DKC (arms)	5.7	5.3	5.2	5.1
Dropout carry-through time at minimum line voltage (ms)	500	500	500	500

Table 8. 3-Phase 60 Hz Operation

Specification	60 Hz-V1	60 Hz-V2s	60 Hz-V3
Nominal rated voltage (vac)	200	208	230
Minimum operating voltage (vac)	184	191	212
Maximum operating voltage (vac)	212	220	244
Rated line current (arms)	15	14.7	13.2
Dropout carry-through time at minimum line voltage (ms)	500	500	500

Table 9. 3-Phase 50 Hz Operation

	50 Hz-V1	50 Hz-V2s	50 Hz-V3	50 Hz-V4	50 Hz-V5	50 Hz-V6	50 Hz-V7
Nominal rated voltage (vac)	200	220	230	240	380	400	415
Minimum operating voltage (vac)	184	202	212	221	350	368	382
Maximum operating voltage (vac)	212	233	244	254	403	424	440
Rated line current (arms)	15	13.8	13.2	12.6	9.9	9.6	9.5
Dropout carry-through time at minimum line voltage (ms)	500	500	500	500	500	500	500

---

## **THE HP SURESTORE E DISK ARRAY XP48 HARDWARE**

---

## General Safety Guidelines

Read the following safety guidelines carefully and follow them when you work with your XP48 disk array.

- Remember that the maintenance of your machine must be done only by trained and qualified HP field engineers. Only an HP Service Representative can power off the disk array.
- Please read and follow the safety guidelines and procedures in this manual and any of your related manuals.
- In this manual and on the machine, hazard warnings are provided to aid you in preventing or reducing the risk of death, personal injury, or product damage. Understand and follow these hazard warnings fully.
- The hazard warnings that appear on the warning labels on the machine or in the manual have one of the following alert headings consisting of an alert symbol and a signal word, **“Warning”** or **“Caution”**:



---

### Warning

This indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

The alert symbol shown left precedes every signal word for hazard warnings and appears in safety-related descriptions in the manual.

---

---

### Caution

*This indicates a hazardous situation which, if not avoided, will or can result in serious damage of product or loss of data.*

---

- The signal word “NOTICE” is used to present warnings that are not directly related to personal injury hazards.
- When warning labels become dirty or start peeling off, replace them.

- If any physical accident such as abnormal noise, smell, or smoke occurs on the disk subsystem while running, immediately power off the disk subsystem by pulling the UNIT EMERGENCY POWER OFF switch on the disk subsystem.
- Do not power off the system unless it is a UNIT EMERGENCY POWER OFF situation.
- Keep the front and rear doors closed at all times.
- Keep the tops and sides of the cabinets clear to allow air to flow properly.
- Do not perform any procedures not described in this document. If you have any questions or concerns, please contact your HP Service Representative.



---

## Warning

Do not touch areas marked HAZARDOUS, even with the power off. These areas contain high-voltage power.

---

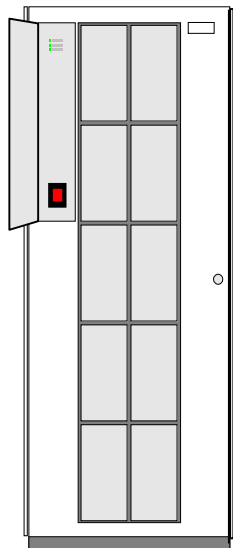
Keep in mind that the hazard warnings in this manual or on the machine cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand.

Be alert and use your common sense. If you have any questions, contact your HP Service Representative.

---

## Physical Components

Your HP SureStore E Disk Array XP48 is a high-performance disk array system. It is used to store large quantities of data in an efficient and secure manner.



*Figure 7. HP SureStore E Disk Array XP48*

Your disk array has the following major hardware components:

- disk array cabinet

The single disk array frame cabinet contains the control panel, connection hardware, the service processor, control boards, and hard disk drives.

- one service processor (SVP)

The SVP is a built-in PC inside the disk array cabinet. The SVP gives your HP Service Representative a method to access the software system on the disk array.



Your HP Service Representative uses the SVP to configure, maintain, and upgrade your disk array software and hardware. The service processor also collects performance data on the disk array for diagnostic testing and analysis.

To protect the user's security, the SVP does not have access to any user data stored on the disk array.

- control panel

The control panel is your view to the disk array. Once the disk array is powered on and running normally, there are no user operations required at the control panel (except in the case of a power failure recovery). The control panel will be discussed in further detail on page 51.

- hard disk drives

Your disk array uses 3.5-inch disk drives, and different disk capacities are available. Ask your HP Service Representative about currently available disk drives or visit the XP48 website at

**[www.hp.com/support/xp48](http://www.hp.com/support/xp48)**. Any of the disk drives in your disk array frames can be replaced without disrupting user activity. The disk array automatically detects and corrects disk errors.

- (Optional) one remote console PC

The remote console PC is attached to your disk array by a private local area network (LAN). The remote console PC runs applications that allow you to monitor and manage the disk array operations.

The following figure illustrates how the remote console and host connect to the XP48.

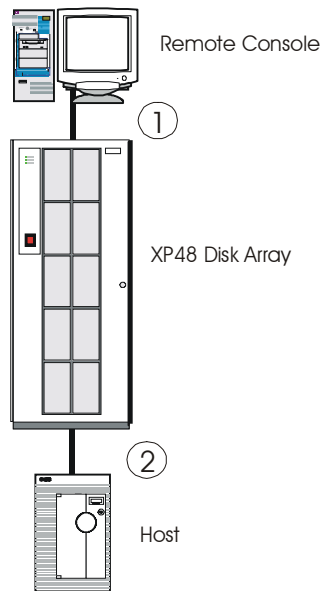


Figure 8. The XP48 Connections

1. The remote console connects via the XP48 LAN connection. The XP48 has an Ethernet connection to connect your disk array to a private LAN or a public (Internet) LAN.
2. The host server uses a Fibre Channel or ESCON connection.

The specific hardware requirements for your remote console PC, such as the required processor speed, storage capacity, and memory, will vary depending on the optional software that you use and the number of disk array frames you have connected to the system.

To protect your users' security, the remote control software for the remote console PC does not have access to any user data stored on the disk array.

There is no single point of failure in the disk array. It is designed with redundant controllers and redundant power supplies, all of which can be removed or replaced without interrupting access to your data.

---

**Caution** Only your HP Service Representative can remove or replace hardware.

---

# Control Panel

Figure 9 and table 10 (page 52) show the control panel and its functions, respectively.

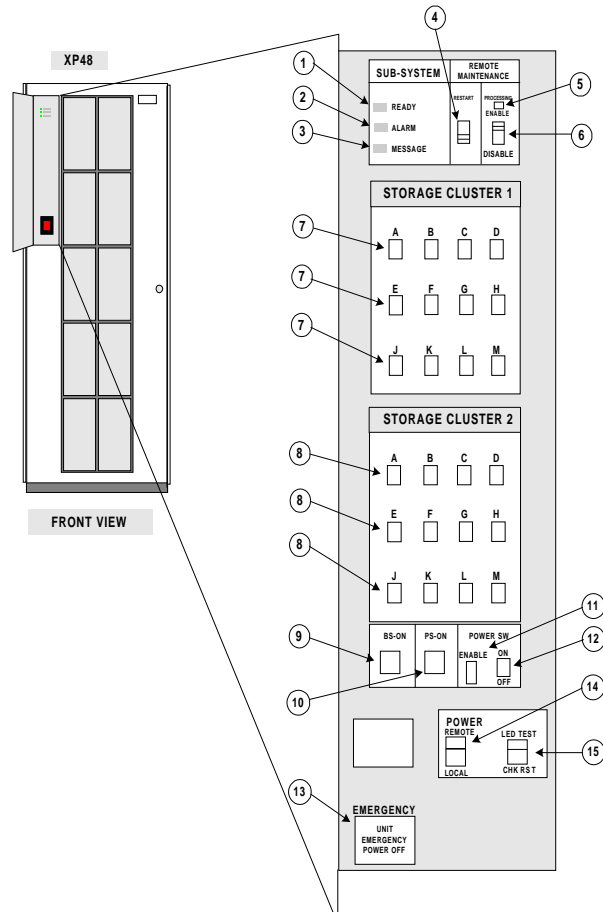


Figure 9. Control Panel

Table 10. Part Function on Control Panel

Item	Label	Indicator	Description
1	SUBSYSTEM READY	LED (Green)	Indicates that input/output operation on the channel interface is enabled. If the LED is off, the system is not accepting data.
2	SUBSYSTEM ALARM	LED (Red)	Indicates DC under voltage, DC over current, abnormally high temperature, or an unrecoverable failure has occurred. Expect a call from your HP Service Representative.
3	SUBSYSTEM MESSAGE	LED (Amber)	Indicates that any message has been issued from Clusters. Phone Home paging is enabled and your HP Service Representative has been notified.
4	SUBSYSTEM RESTART	Switch	Used to unfence the fenced drive path and to release Write Inhibit. There is a blocked path somewhere between a host and a disk drive. By restarting the subsystem, a soft reset will be performed to try to recover. If system restart does not unblock the path, an HP Service Representative will be notified.
5	REMOTE MAINTENANCE PROCESSING	LED (Amber)	Indicates that remote maintenance is being processed. An HP Service Representative is probably working on your system, but the system is online and accepting data.
6	REMOTE MAINTENANCE ENABLE/DISABLE	Switch	Used to permit remote service maintenance. Disable: No one can provide maintenance Enable: HP Service Representative can provide maintenance.

(continued)

Table 10. Part Function on Control Panel (continued)

Item	Label	Indicator	Description
7	STORAGE CLUSTER 1  CHANNEL A-R ENABLE	LED (Green)	Serial Channel/Fibre Channel:  (1) On: Indicates some of the logical paths are established.  (2) Fast blinking: Indicates that the corresponding channel route is executing the channel command. (Only Serial Channel)  (3) Slow blinking: Indicates none of the logical paths are established.  (4) Off: Indicates that the corresponding channel route is not enabled.
8	STORAGE CLUSTER 2  CHANNEL A-R ENABLE	LED (Green)	Serial Channel/Fibre Channel:  (1) On: Indicates some of the logical paths are established.  (2) Fast blinking: Indicates that the corresponding channel route is executing the channel command. (Only Serial Channel)  (3) Slow blinking: Indicates none of the logical paths are established.  (4) Off: Indicates that the corresponding channel route is not enabled.

(continued)

Table 10. Part Function on Control Panel (continued)

Item	Label	Indicator	Description
9	BS ON	LED (Yellow)	<p>When the LED is on, unit is plugged in and receiving power from the primary AC outlet. The SVP is receiving power from the outlet.</p> <p>If BS is off, then the disk array is not receiving power from the primary AC outlet. Check the electrical outlets in your building.</p>
10	PS ON	LED (Green)	<p>When the LED is on, the power switch is on, and the array is ready to receive data.</p> <p>Off means the power switch is off; the disk array is not powered on and is not ready to receive data.</p>
11	PWR SW ENABLE	Switch	Used to enable the PWR on/off switch. To enable the PWR on/off switch, turn the PWR SW ENABLE switch to the ENABLE position.
12	PWR ON/PWR OFF	Switch	To switch on/off the subsystem, use this switch while turning the PWR SW ENABLE switch to the ENABLE position. This switch is valid when the REMOTE/LOCAL switch is set to the LOCAL position.
13	UNIT EMERGENCY POWER OFF	Switch	Used to power off the storage subsystem in an emergency situation.
14	PWR ON/PWR OFF REMOTE/LOCAL	Switch	<p>Determines how the disk array is powered on or off.</p> <p>REMOTE: Disk array is powered on/off by the instructions of the CPU.</p> <p>LOCAL: Disk array is powered on/off by the PWR ON/PWR OFF switch.</p>
15	LED TEST/CHK RESET	Switch	<p>LED TEST position: The LEDs on the panel go on.</p> <p>CHK RESET position: The PS and THERMOCOUPLE alarms are reset.</p>

---

## UNIT EMERGENCY POWER OFF

A switch is provided on the control panel for an emergency powering off.

If you encounter any abnormality such as an abnormal sound, smell, or smoke, power off the disk subsystem by operating the UNIT EMERGENCY POWER OFF switch following the procedure below. The procedure for operating the switch is as follows:

1. Push the control panel cover at the portion where PUSH is marked, open the control panel cover, then operate the UNIT EMERGENCY POWER OFF switch.
2. In using a UNIT EMERGENCY POWER OFF switch, first pull it up and then pull it toward you as illustrated in figure 10 (page 56).

---

**Caution** *Pulling the UNIT EMERGENCY POWER OFF switch on the disk array cabinet instantly shuts down the array, neglecting the system's power-off sequence. Jobs in process are aborted and their integrity after recovery is not guaranteed. Therefore, this method should be used only in an emergency and not in normal operation.*

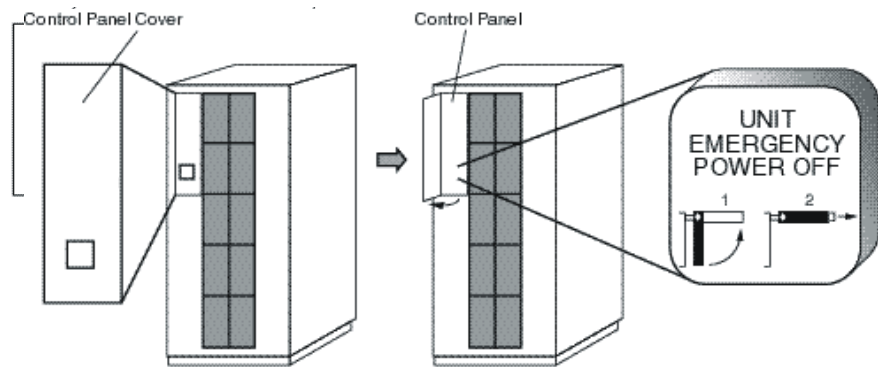
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**Caution** *The UNIT EMERGENCY POWER OFF switch on the disk array cabinet only partially restores power from the array. AC input power remains present at the primary circuit. Therefore, do not use the UNIT EMERGENCY POWER OFF switch unless you need to power off the unit as an emergency measure.*

---

When pulled, a UNIT EMERGENCY POWER OFF switch locks itself to prevent further powering on and requires a trained and qualified HP field engineer for recovery.



*Figure 10. Pulling the UNIT EMERGENCY POWER OFF Switch*



---

## Normal Operations

The disk array does not require intervention from the user. The disk array reports any remote error messages (R-SIMs) to your remote console PC and also sends the report to the HP Service Center automatically.

The RC software allows the HP Service Representative to view the R-SIMs by date and time or by controller and to manage the R-SIM log file on the remote console PC. For more information on SIMs, see “Troubleshooting” (page 77).

---

## Powering Off the Disk Array

Situations may arise in the operation of the disk array that require the user to power off the disk array. These situations include:

- UNIT EMERGENCY POWER OFF
- Planned power-off

### UNIT EMERGENCY POWER OFF

An emergency is a critical situation such as a physical plant catastrophe such as a flood, hurricane, tornado, or a threat of injury or death to a person. In an emergency, the critical need is to quickly remove power from the disk array. A quick restart is not necessary.

In an emergency, the operator should trip the UNIT EMERGENCY POWER OFF switch. The disk array UNIT EMERGENCY POWER OFF switch is located on the control panel.

---

**Caution** *Use this switch only in case of an emergency. An HP Service Representative is required to reset the UNIT EMERGENCY POWER OFF and to power on the disk array.*

---

#### To power off the disk array in an emergency:

1. Open the control panel cover by pushing on the point marked **PUSH**.
2. Pull the UNIT EMERGENCY POWER OFF switch (figure 10 (page 56)) up and then out toward you as illustrated on the switch.
3. Call the HP support center. The UNIT EMERGENCY POWER OFF switch must be reset by an HP Service Representative before the disk array can be powered on again.

## Planned Power-Off

There may be times when a site power outage is planned. These situations would include alterations to the data center, inspections, or work by the electric company. If a scheduled power outage affects an HP SureStore E Disk Array XP48, the power off of the disk array must be scheduled with a trained HP support representative.

---

**Caution** *Only a trained HP representative can shut down and power off a disk array. Shutting down and powering off a disk array is not a customer activity. A user should not attempt to power down the disk array at any time other than an emergency.*

---

When planning for your planned power outage, please contact your HP CE to schedule a customer visit.

---

## Recovering from a Power Outage to the Disk Array

A power outage to the array is when the primary building power is lost due to electrical blackouts, thunderstorm activity, etc., and input AC power is not received by the array. The disk array will maintain its state and recover when power is restored. The array cache is backed up by batteries that will maintain its state for a minimum of 48 hours. This length of time will provide coverage for most outages. In cases where the outage will extend beyond 48 hours, the batteries can be replaced by an HP CE, which will extend the time, if necessary.

---

**Caution** *After power is restored to the customer site and before restoring power to the disk array, HP recommends verification of power by an electrician to ensure all phases are restored and input power to the disk is stable.*

---

The user may opt to call a trained HP representative to recover from the disk array power failure. The user may also use the following procedures for disk array power-failure recovery:

1. Move the REMOTE/LOCAL switch on the front panel (14, figure 9 (page 51)) to the LOCAL position. The normal position is REMOTE.
2. Hold down the ENABLE switch while toggling the PWR ON/OFF switch to the PWR ON position (11/12, figure 9 (page 51)).
3. The following LED power sequence will occur:

The BS-ON (9, figure 9 (page 51)) will turn amber, and the PS ON LED (10, figure 9 (page 51)) will turn green.

The CHANNEL LED (7, figure 9 (page 51)) will light green for every adapter installed.

The MESSAGE LED (3, figure 9 (page 51)) will turn amber signifying a SIM was generated (because the disk array went down unexpectedly).

Finally, the Ready LED (1, figure 9 (page 51)) will light green signifying the system is ready.

---

**Caution** *Powering on the disk array may take upwards of 10 minutes, depending on the number of disks installed in your disk array. Power-on is complete only when the READY LED turns green.*

---

4. Move the REMOTE/LOCAL switch on the front panel (14, figure 9 (page 51)) to the REMOTE position.

---

# Specifications

Some of the XP48 disk array specifications are listed in this section. Refer to the HP SureStore E Disk Array 48 Site Prep Guide in the XP48 [www.hp.com/support/xp48](http://www.hp.com/support/xp48) for a complete set of XP48 specifications.

## Temperature

Table 11. Temperature Specification

Temperature Specification (Degrees F = 1.8 x Degrees C + 32)	
Nonoperating temperature range	–10° to +43°C
Operating temperature	+16° to +32°C
Recommended operating temperature range	+21° to +24°C
Shipping and storage temperature	–25° to +60°C
Temperature shock immunity—maximum rate of change	+10°C per hour
Over-temperature shutdown	Shutdown at +60°C

## Humidity

Table 12. Humidity Specification

Humidity Specification	
Nonoperating/storage humidity range	8% to 90% RH
Operating humidity range at 22°C	20% to 80% RH
Recommended operating humidity range at 22°C	50% to 55% RH
Procedure for recovery from moisture condensation	None

## Mechanical Vibration

Maximum operating  
acceleration

0.05G at a frequency range of 10 to 300 Hz

## AC Line Voltage

The following tables detail the AC line voltage.

*Table 13. 1-Phase 60 Hz Operation*

Specification	60 Hz-V1	60 Hz-V2s	60 Hz-V3
Nominal rated voltage(vac)	200	208	230
Minimum operating voltage (vac)	184	191	212
Maximum operating voltage (vac)	212	220	244
Rated line current (arms)	8.8	8.5	7.8
Dropout carry-through time at minimum line voltage (ms)	500	500	500

*Table 14. 1-Phase 50 Hz Operation*

Specification	50 Hz-V1	50 Hz-V2s	50 Hz-V3	50 Hz-V4
Nominal rated voltage (vac)	200	220	230	240
Minimum operating voltage (vac)	184	202	212	221
Maximum operating voltage (vac)	212	233	244	254
Rated line current (arms)	8.8	8.2	7.8	7.5
Dropout carry-through time at minimum line voltage (ms)	500	500	500	500

---

## Website

For the most current information on the XP48, please visit the XP48 website at **[www.hp.com/support/xp48](http://www.hp.com/support/xp48)**.



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# THE HP SURESTORE E DISK ARRAY XP FAMILY OF OPTIONAL SOFTWARE

There are several optional software packages available from HP designed to increase your data accessibility and enable continuous user data access to your disk array. This chapter describes how these optional software applications help you to run your disk array system.

Before installing the optional software packages, refer to the specific software manual to verify equipment requirements.

---

## Web-Based Console

This section lists the advantages of creating a web-based console using the HP SureStore E Command View.

### HP SureStore E Command View XP

The SureStore E Command View XP provides you with the next generation of management and the ability to manage multiple disk arrays. Command View provides:

- common web-GUI interface across XP platforms
- quick installation via InstallShield
- the ability to manage your storage resources from any location, enabling the remote expert to participate in problem management without traveling
- visual representation of host and storage resources
- view status and health of storage resources graphically
- integration into leading management products

---

# Security

The following section explains how to use the Secure Manager to establish security on your disk array.

## HP SureStore E Secure Manager XP

Secure Manager establishes security at the LUN level, allowing you to enable multiple server connectivity to the disk array. Secure Manager XP works through the native Fibre Channel, enabling the disk array to hide LUNs assigned to one server from other servers during IOSCAN operations.

---

## Core Solutions

There are three applications that provide core solutions: Cache LUN, LUN Configuration Manager, and Remote Control.

### HP SureStore E Cache LUN XP

Using Cache LUN for storage in cache increases access time to data.

### HP SureStore E LUN Configuration Manager XP

The LUN Configuration Manager allows you to create, define, and configure LUNs on your disk array. LUN Configuration Manager comes with three applications that are executed on the SureStore E Command View console or your remote control PC.

LUN Configuration Manager enables

- LUN creation and port assignment
- consolidation of LUNs (up to 36 LUNs can be combined)
- creation of small-size LUNs to accommodate data locked into cache

### HP SureStore E Remote Control XP

Included with HP SureStore E Command View XP is Remote Control, which provides customers with an alternative interface to accessing SureStore E disk array resources. See figure 11 (page 69). Remote Control is installed on a PC, provided by the customer, running Microsoft Windows 95/98 or NT 4.0. Remote Control XP can manage up to eight disk arrays.

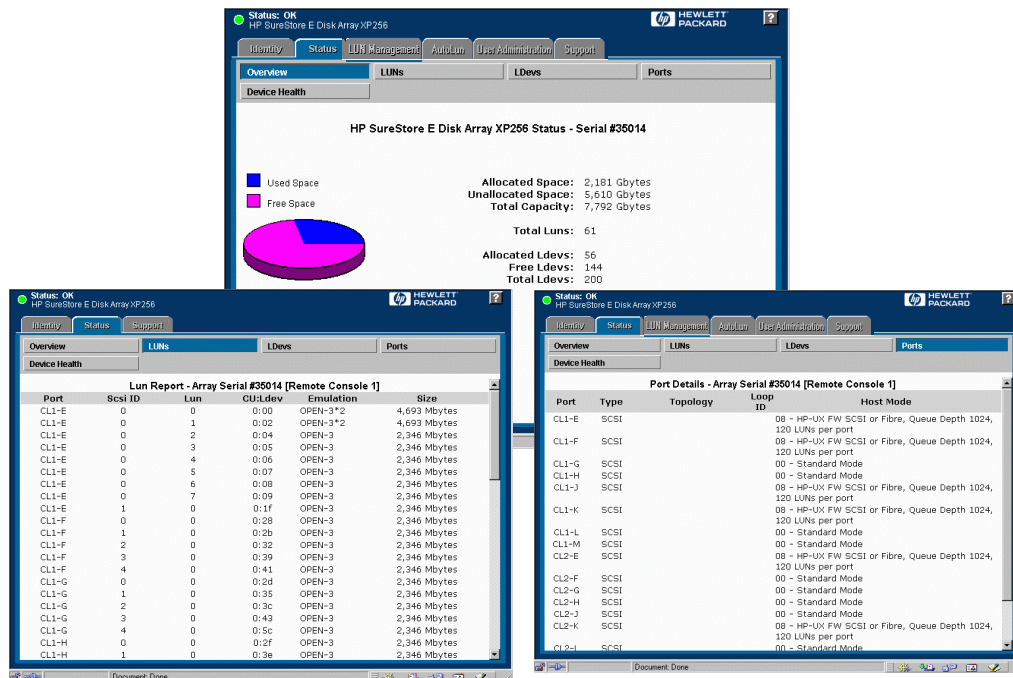


Figure 11. Remote Control XP Menus

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## Disaster Recovery

Disaster recovery applications include Continuous Access XP and Continuous Access Extension XP.

### HP SureStore E Continuous Access XP

Continuous Access XP allows you to implement a disaster recovery plan by providing a link between the failover controller/arbitrator and your disk array to initiate, monitor, and report its status to the host.

Continuous Access software allows you to make a synchronous copy of a remote data site, mirroring it to a remote site up to 27 miles (43 kilometers) away. Remote Access includes host-specific software that enables you to have full user control from the host server via a command-line interface.

### HP SureStore E Continuous Access Extension XP

Continuous Access Extension XP enables a high-performance asynchronous copy mode that allows confirmation of host write operations between your local disk array and a remote disk array. These operations are sequenced-stamped to ensure they are executed and sorted correctly at the remote disk array.

You must purchase Continuous Access Extension as an upgrade if you are currently using the Continuous Access XP in synchronous mode, but would prefer to use asynchronous mode.

---

## High Availability

High availability is enabled by using the optional Business Copy XP software.

### HP SureStore E Business Copy XP

Business Copy XP allows you to enable multiple mirroring capabilities to create a total of 10 images, including the original. Use Business Copy for nonproduction activities such as backup, batching, and system testing.

---

## Failover and Load Balancing

Enhance failover and load balancing with Auto LUN XP, Auto Path XP, and Performance Manager XP.

### HP SureStore E Auto LUN XP

Auto LUN XP provides monitoring and disk usage analysis for your disk array based on user thresholds. Auto LUN develops a plan to migrate impacted data volumes to lower usage LUNs, using the data acquired during the monitoring function. You can perform the migration manually or automatically, or you can set it to complete with the approval of the user.

### HP SureStore E Auto Path XP

Using Auto Path XP, you can enable Windows NT server I/O path failover and load balancing control for dual path connections. You can configure up to eight multiple paths per LUN that will provide automatic and transparent failover in the event of path failure. You can also enable dynamic, multipath load balancing to prevent overloaded I/O operations.



---

# Performance Monitoring

Monitor the performance of your disk array with Performance Manager XP and Performance Advisor XP.

## HP SureStore E Performance Manager XP

Performance Manager XP provides performance monitoring for your disk array and allows you to adjust disk array performance. The Performance Manager enables you or your service consultant to examine your system's workload and to perform reallocation of cache read and write ratios according to user needs.

Performance Manager monitors your hardware performance, cache statistics, and I/O statistics of your attached disk arrays. You can display real-time and historical data as graphs using the Performance Manager.

## HP SureStore E Performance Advisor XP

HP SureStore E Performance Advisor XP is an Internet application used to collect and monitor real-time performance of the HP SureStore E XP family of disk array products. Using a simple, browser-based interface, you can quickly customize performance data collection and set performance alarms. Performance Advisor provides real-time and historical data on:

- LDEV I/O
- front-end and back-end port utilization
- internal bus utilization
- cache usage

You can easily integrate with the VantagePoint DSI log and user PerfView to view your performance metrics.

---

## Network Management

Network management is established using the SureStore E OpenView/ITO SPI software.

### HP SureStore E OpenView/ITO SPI

SureStore E OpenView/ITO SPI establishes an agent that resides on your remote control PC agent, monitors the disk array, provides a correlation of events on the disk array, and then forwards those events to the OpenView/ITO management console.

---

## Mainframe Solutions

Use the Resource Manager and Data Exchange software applications to meet your mainframe requirements.

### HP SureStore E Resource Manager XP

The Resource Manager allows you to share data stored on the disk array with mainframe systems as well as open system servers. This reduces and optimizes your storage maintenance and management overhead.

### HP SureStore E Data Exchange XP

Data Exchange XP provides high-speed bidirectional data sharing between mainframe systems via the ESCON links and the SCSI links on open systems. File translations are provided through a file conversion utility.



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## TROUBLESHOOTING

This chapter explains the monitoring and reporting capabilities and the flow of troubleshooting used on the HP SureStore E XP Family of disk arrays.

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## Monitoring and Reporting

Your disk array generates service information messages (SIMs) to identify normal operations, service requirements, and failures. SIMs can be generated on your disk array by the CHIP (Client Host Interface Processor) and ACP (array control processor) microprocessors and by the internal service processor (SVP). Your HP Service Representative will use the SIMs to monitor and troubleshoot your disk array.

---

## Troubleshooting Flow Diagram

When your system encounters trouble, it will report the trouble to the remote PC and to the HP Stress Free Central Support Center.

If a failure occurs in your disk array, it is detected and reported to the system log, the SIM log, and the HP Technical Support Center. Figure 12 (page 80) is a flow diagram that explains the progress of error detection and reporting.

1. A failure is detected in your disk array.
2. The failure is reported to the system.

The system stores the failure information in the system log.

3. The generated SIMs are stored on the SVP of your disk array for use by HP personnel and logged on the remote console PC as remote SIMs (R-SIMs). The Continuous Track remote maintenance software tool also reports SIMs to the HP Stress Free Central Support Center. When a SIM is generated, the amber message LED on your disk array control panel turns on.

The R-SIM feature of the remote console PC allows you to view the R-SIMs reported by the disk array from your remote console PC and from the open-system host. The R-SIM feature uses the simple network management protocol (SNMP) for complete remote disk array management. The remote console PC displays a warning message each time a SIM is reported, even when the remote console software is not running.

SIMs are classified according to severity: service, moderate, serious, or acute. Service-level and moderate-level SIMs do not require immediate attention and are addressed during routine maintenance. These failures are often corrected before the failure actually occurs.

Serious-level and acute-level SIMs are reported to the HP Stress Free Central Support Center immediately to ensure that the problem is addressed as soon as possible. Your HP Service Representative will configure your modem during installation.

4. The Continuous Track remote maintenance tool reports the SIMs to the HP Stress Free Central Support Center through a dedicated dial-up connection.

The HP Stress Free Central Support Center then takes action to correct the failure.

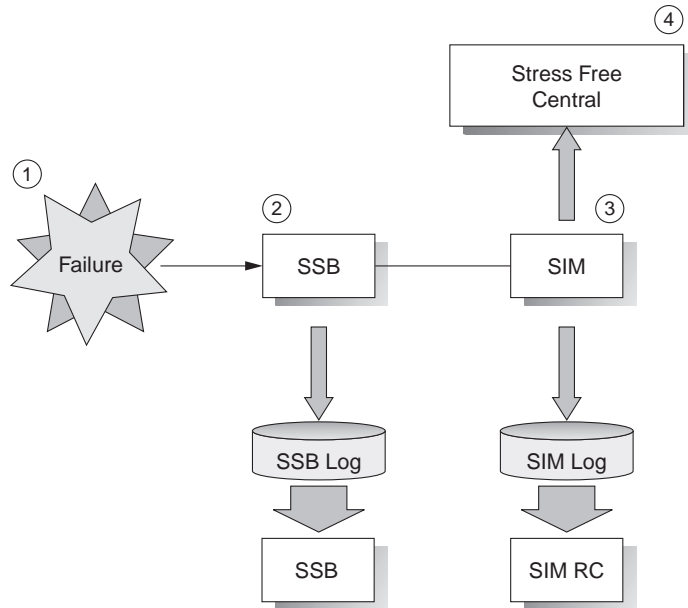


Figure 12. Error Detection and Reporting



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# REGULATORY STATEMENTS

The following regulatory statements relate to both the HP SureStore E XP512 and the HP SureStore E XP48 disk arrays, unless otherwise noted.

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## FCC EMC Statement (USA)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense. The end user of this product should be aware that any changes or modifications made to this equipment without the approval of Hewlett-Packard could result in the product not meeting the Class A limits, in which case the FCC could void the user's authority to operate the equipment.

Hewlett-Packard's device certification tests were conducted with HP computer systems and HP shielded cables, such as those you received with your product. Changes or modifications not expressly approved by Hewlett-Packard could void the user's authority to operate the equipment. Cables used with this device must be properly shielded to comply with the requirements of the FCC.

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## IEC Statement (Worldwide)

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

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## EMC Statement (Canada)

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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## Spécification ATI Classe A (France)

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION  
d'un matériel de traitement de l'information (ATI), classé A en fonction des  
niveaux de perturbations radioélectriques émis, définis dans la norme  
européenne EN 55022 concernant la Compatibilité Electromagnétique.

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## VCCI EMC Statement (Japan)

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

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## BSMI EMC License Number and Statement (Taiwan)

### XP512

警告使用者：這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

檢磁 3892H508

### XP48

警告使用者：這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

檢磁 3892H052

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## Harmonics Conformance (Japan)

高調波ガイドライン適合品



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## German Noise Declaration

XP512: Schalldruckpegel  $L_p = 62 \text{ dB(A)}$

XP48: Schalldruckpegel  $L_p = 59 \text{ dB(A)}$

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1988 / EN 27779:1991 (Typprüfung)

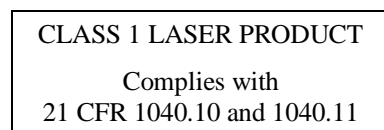
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## Laser Safety

When equipped with native Fibre Channel adapters, this product contains a laser internal to the optical link module (OLM) contained on the 4-port Fibre Channel Adapter board and on the 8-port Fibre Channel Adapter board for connection to a fibre communications network.

In the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the plastic OLM housing. Outside the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The following figure shows the Class 1 information label that appears on the plastic housing of the OLM.



Each communications port consists of a transmitter and receiver optical subassembly. The transmitter subassembly contains internally a semiconductor laser diode in the wavelength range of 770 to 850 nanometers. In the event of a break anywhere in the fibre path, the OLM control system prevents laser emissions from exceeding Class 1 levels. Class 1 laser products are not considered hazardous.



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### Warning

There are no user maintenance operations, service operations, or adjustments to be performed on the optical link module.

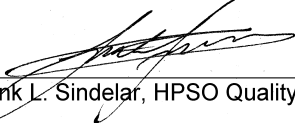
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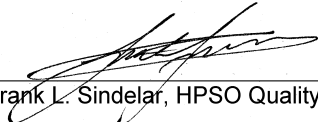
## Declaration of Conformity

The following declarations pertain to the XP512 and the XP48, respectively.

## XP512 Declaration of Conformity

<b>DECLARATION OF CONFORMITY</b> according to ISO/IEC Guide 22 and EN 45014	
<b>Manufacturer's Name:</b>	Hewlett-Packard Company
<b>Manufacturer's Address:</b>	8000 Foothills Blvd. Roseville, CA 95747 USA
<b>declares, that the product</b>	
<b>Product Name:</b>	SureStore E Disk Array XP512
<b>Model Number(s):</b>	A5951A, A5965A, A5965U
<b>Product Options:</b>	All
<b>conforms to the following Product Specifications:</b>	
Safety:	IEC 950:1991 + A1, A2, A3, A4 / EN 60950:1992 + A1, A2, A3, A4, A11 GB 4943-1995 IEC 825-1:1993 +A1 / EN 60825-1:1994 + A11 – Class 1 (Laser/LED)
EMC:	CISPR 22:1997 / EN 55022:1998 – Class A <sup>1</sup> GB 9254-1988 CISPR 24:1997 / EN 55024:1998 IEC 61000-3-2:1995 / EN 61000-3-2:1995 IEC 61000-3-3:1994 / EN 61000-3-3:1995
<b>Supplementary Information:</b>	
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.	
1) The Product was tested in a typical configuration with an HP 9000 computer system.	
Roseville, May 4, 2000	 Frank L. Sindelar, HPSO Quality Mgr.
European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Straße 130, D-71034 Böblingen (FAX: + 49-7031-14-3143)	

## XP48 Declaration of Conformity

<b>DECLARATION OF CONFORMITY</b> according to ISO/IEC Guide 22 and EN 45014	
<b>Manufacturer's Name:</b>	Hewlett-Packard Company
<b>Manufacturer's Address:</b>	8000 Foothills Blvd. Roseville, CA 95747 USA
<b>declares, that the product</b>	
<b>Product Name:</b>	SureStore E Disk Array XP48
<b>Model Number(s):</b>	A5921A, A5921AR
<b>Product Options:</b>	All
<b>conforms to the following Product Specifications:</b>	
Safety:	IEC 950:1991 + A1, A2, A3, A4 / EN 60950:1992 + A1, A2, A3, A4, A11 GB 4943-1995 IEC 825-1:1993 +A1 / EN 60825-1:1994 + A11 – Class 1 (Laser/LED)
EMC:	CISPR 22:1997 / EN 55022:1998 – Class A <sup>1</sup> GB 9254-1988 CISPR 24:1997 / EN 55024:1998 IEC 61000-3-2:1995 / EN 61000-3-2:1995 IEC 61000-3-3:1994 / EN 61000-3-3:1995
<b>Supplementary Information:</b>	
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.	
1) The Product was tested in a typical configuration with an HP 9000 computer system.	
Roseville, October 3, 2000	 Frank L. Sindelar, HPSO Quality Mgr.
European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Straße 130, D-71034 Böblingen (FAX: + 49-7031-14-3143)	



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## RAID TECHNOLOGY

RAID technology is used by your HP SureStore E Disk Array to utilize your disk space efficiently and to keep your data safe in case a problem occurs with one of your disk drives.

RAID technology combines low cost and high performance, while providing you with high reliability. RAID technology separates your data and your disk drives into disk arrays and disk volumes. These divisions are used to safeguard data and to make the most efficient use of your disk drive space.

Two RAID types are supported on the XP512 and XP48. Which RAID type you need depends on the type of data storage solution you require.

In most situations, RAID0/1 will have better performance over RAID5. If the host application is write-intensive, there should not be many, if any, performance differences between either of the two RAID groups. If the host application is more read-intensive, you will see some performance differences between the two RAID groups.

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## Using RAID0/1

RAID0/1 uses both RAID0 and RAID1 technologies implemented together to achieve high reliability and high I/O performance on your disk array.

RAID0 produces a striped drive volume. Striped data means that the stream of data from the host is split and distributed onto two or more of your disk devices on a byte or bit basis. RAID0 produces a very high-performance I/O disk subsystem, where fault tolerance is not required.

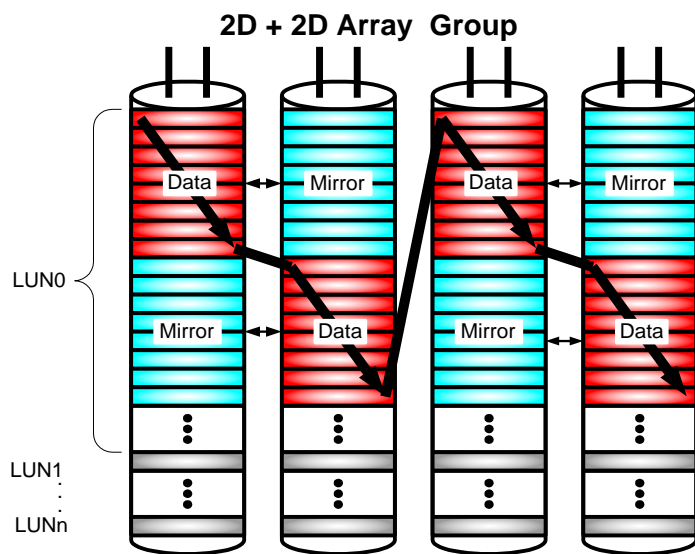
RAID1 is a disk-mirroring algorithm that requires at least two disk drives. RAID1 produces a mirrored drive volume. RAID1 is the simplest of RAID technologies because of the nature of mirrored storage. The RAID controller writes the data to both duplex areas of cache. After the first write to your primary disk is complete, the secondary copy of data in cache is written out to your secondary disk. After the writes to both disks have completed, the write cache is released. RAID1 arrays are fault tolerant, but they have lower performance than RAID0 arrays.

As mentioned earlier, RAID0/1 adds the high I/O performance features of RAID0 striping to the high-reliability features of mirrored storage of RAID1. RAID0/1 uses all four disks in an array group for the primary storage path. The I/O performance improvements are achieved by splitting the I/O data streams onto all four disks in the array group. Striping the data across the four disks more than doubles the RAID1 performance.

From figure 13 (page 97), you can see how the primary data is physically written across all four drives. The diagram also shows how the secondary portion of the storage array is used for the mirrored copy.

Writes to the array in RAID0/1 mode occur the same as explained for RAID1. The primary side is destaged first. After the primary data has been successfully destaged, the secondary data is destaged to the mirror drive mechanisms.





**RAID0/1 is a striped and mirrored copy within an ACP pair**

*Figure 13. RAID0/1 Array Group*

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## Understanding RAID3

RAID3 is not supported on your XP disk array, but it is a preface to understanding RAID5, which is supported.

RAID3 allows data to be split and distributed on two or more disk drives using striping. Because two or more disk drives are recording the data simultaneously, the transfer speed is faster. The multiple disk drives that are used to store the data are called a parity group. See figure 14 (page 98).

RAID3 stores parity information on a separate drive (called a parity drive). This improves the safety of your data because the parity information can be used to recover the data, even if one of the drives in a parity group has become inoperative or has read errors.

Because RAID3 does not have parallel input/output capability, it must drive two or more drives at the same time. This causes poor performance in applications that process small data files often (transaction processing). RAID3 has good performance when you are using applications that process large data files in a single run (scientific computations).

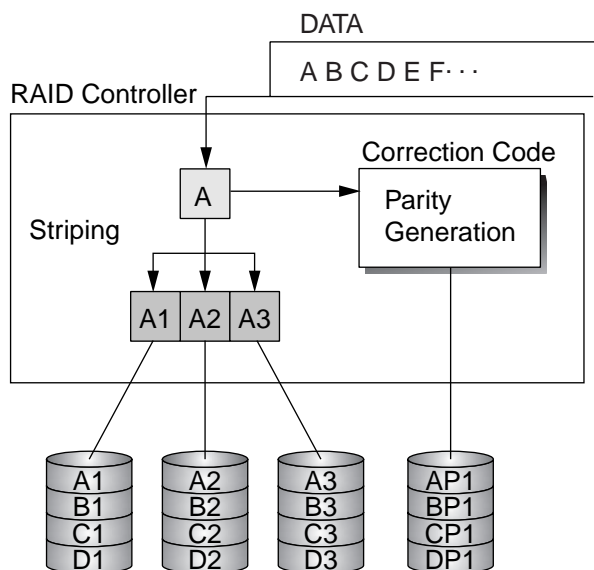


Figure 14. RAID3 Disk Array

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## Using RAID5

RAID5, like RAID3, processes data between two or more disk drives simultaneously. RAID5 also saves parity information to a separate disk drive.

RAID5, unlike RAID3, saves information as blocks of data, which allows the RAID controller to access each disk for only one stripe of data. This also allows RAID5 to perform input/output operations on other disks in parallel. By saving the data as small blocks, this approach permits increased I/O performance. This makes RAID5 ideal for transaction processing.

In large-scale (sequential) input/output operations, RAID5 permits parallel processing of the parity blocks, which increases the data transfer rate.

In small-scale input/output operations though, RAID5 must perform extra read operations from the data and parity disks. This slows the transfer rate and is called write penalty. To limit this problem, RAID5 distributes the parity data on several disks in the parity group.

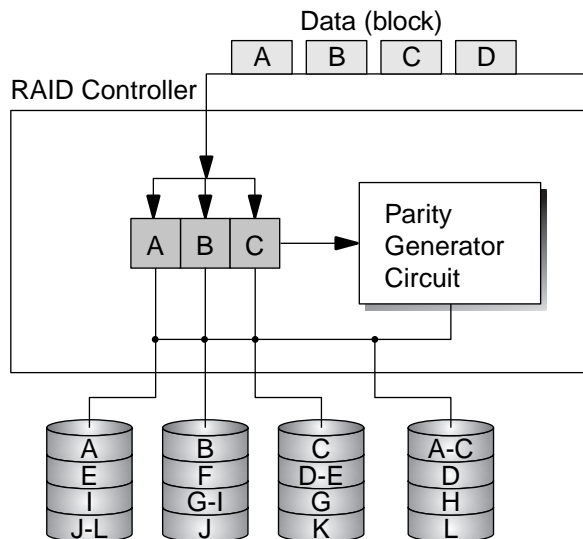


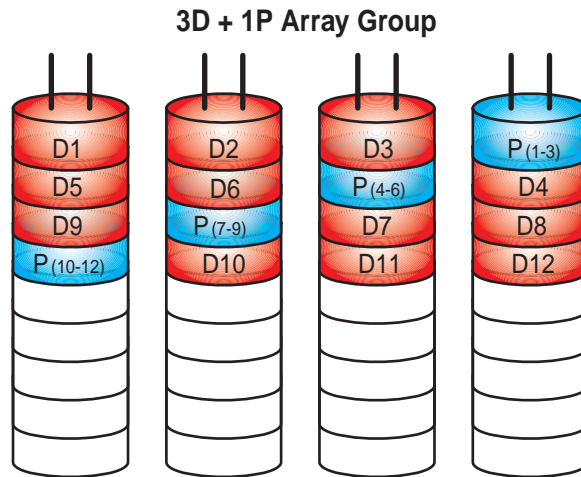
Figure 15. RAID5 Disk Array

RAID5 requires four disks for an array group. RAID5 on the XP512 allows the data to be split and distributed onto three disk drives using striping. Parity data for the group is created and stored on the parity disk as in figure 16 (page 101). Data can easily be recovered if a device in the parity group becomes inoperative or causes a read error.

In RAID5, the striping size is set to that of blocks that are to be transferred. This allows the RAID controller to access each disk for a single stripe equivalence of data and allows the RAID controller to perform I/O operations on other disks in parallel; therefore, increasing I/O performance substantially.

In small-scale or random I/O applications, the data transfer rate remains the same as conventional RAID systems. In large or sequential I/O applications, RAID5 permits the blocks in the same parity group to be processed in parallel, resulting in an increase in the data transfer rate. For small writes to single blocks, RAID5 requires extra reads from the data and parity disks before a small block can be written to the disk. Since the parity data is distributed on all disks in the group, it still allows parallel I/O processing of multiple blocks.

If the parity disk were fixed at a single disk device, the parity disk would be busied during a single write that is executed to update the parity data. This would make it impossible to perform parallel I/O processing because the parity disk would always be busy with the first block of data. This is a problem with RAID3 that RAID5 has alleviated.



*Figure 16. RAID5 with Parity Disk*

The downside to RAID0/1 over RAID5 is that there is a 100% overhead on storage redundancy associated with RAID0/1. RAID0/1 is often referred to as mirrored storage, because the user data is physically duplicated in the array.

You will get more overall usable storage out of the array with a RAID5 implementation. RAID5 achieves the storage redundancy by generating parity data based on the data stored. RAID5 only requires a 33% storage overhead.

*Table 15. RAID Array Usage and Overhead*

RAID Type	Disk Usage	Overhead
RAID 0/1	2 disks + 2 disks	100%
RAID 5	3 disks + 1 parity drive	33%

## Configuring Dynamic Spare Disks

You can configure the disk array with a minimum of 1 and a maximum of 16 spare disk drives. For both RAID0/1 and RAID5 array groups, any dynamic spare drive can back up any other disk drive of the same capacity, anywhere in the disk array, even if the failed disk and the spare disk are on different array control processor (ACP) pairs. The RAID system uses diagnostics and disk-scrubbing algorithms to detect and correct drive errors. The system can encounter errors with the physical drive either from a host I/O request or from background data integrity checking.

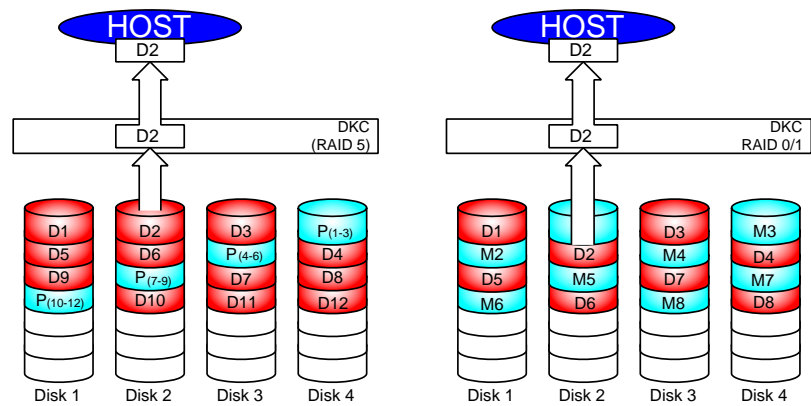


Figure 17. Normal Data Read Operation

If a drive error occurs during an I/O operation from a host, the system can recover the target data using parity data and data stored on the other nonfailing drives. The data can be recovered even when the array subsystem cannot read the data because of errors occurring on the physical drives. This feature ensures nondisruptive processing of applications in case of drive errors. Figure 17 (page 103) shows a normal data read operation. The figure below shows how data is reconstructed after a drive error is encountered.

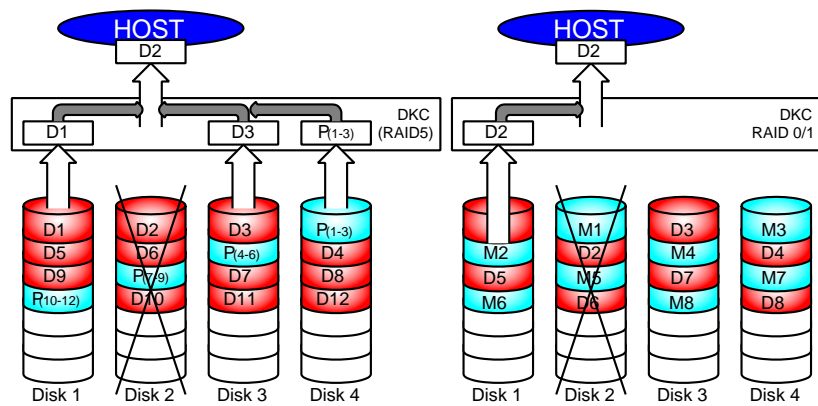
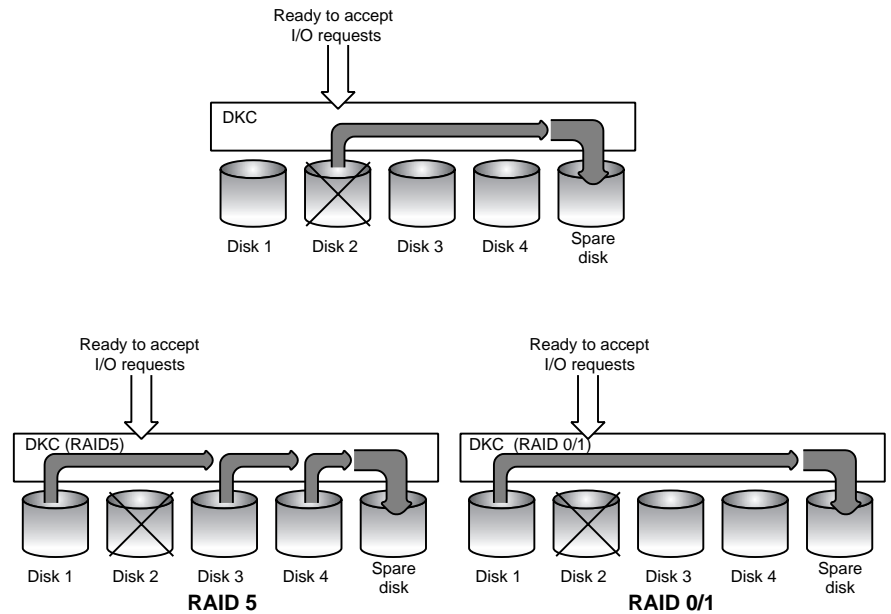


Figure 18. Data Reconstruction After Drive Error

There are two data integrity features built into the XP512: dynamic sparing and correction copy. The XP512 uses spare disk drives and reconfigures any drives that are blocked because of errors or whose error count exceeds a specified limit value.

Since this processing is done in the background, the array can continue to accept host I/O requests. The data saved on spare disks is copied back into the original location after the drive with errors has been replaced with a new one.





*Figure 19. Dynamic Sparing and Correction*

Dynamic sparing is a method of removing a drive from service if its read/write errors exceed a certain threshold value. On normal read and write operations, the array keeps track of the number of errors that occur. If the error threshold is reached, the system considers that the drive is likely to cause an unrecoverable error and automatically copies the data from that drive to a spare disk. The dynamic sparing method used in the XP512 is the same for both RAID0/1 and RAID5.

Correction copy is invoked when the system encounters an unrecoverable error occurring on a drive. In RAID5, correction copy will regenerate the original data for that drive using the data from the other two drives and the parity data, and then the controller copies the regenerated data onto the spare disk. In RAID0/1, correction copy just has to copy the data from the mirrored disk onto the spare disk. After a failed disk has been replaced, the data is moved back to its original location, and the spare disk is then available as an active spare.



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## GLOSSARY

<b>ACP</b>	array control processor
<b>ADP (ADaPter)</b>	Hardware that connects the LCM to the CHA physically and logically. The ADP contains 256 MB of internal buffer.
<b>AL</b>	arbitrated loop
<b>AP</b>	application program
<b>BC</b>	XP SureStore E Business Copy XP software
<b>BS</b>	basic supply
<b>BSA (BUS Adapter)</b>	Hardware that connects the PCBs, FBUS, and MBUS.
<b>BTU</b>	British thermal unit
<b>°C</b>	degrees centigrade/Celsius
<b>CA</b>	XP SureStore E Continuous Access XP software
<b>ca</b>	cache
<b>cache</b>	Intermediate buffer between the channels and drives. It is available and controlled as two areas of cache (cache A and cache B). It is fully battery-backed (48 hours).
<b>CE</b>	customer engineer
<b>CFW</b>	cache fast write
<b>CH</b>	channel

<b>CHA (CHannel Adapter)</b>	Provides the channel interface control functions and intercache data transfer functions. It is used to convert the data format between CKD and FBA. The CHA contains an internal processor and 128 bytes of edit buffer memory.
<b>CHA (Prog.)</b>	A channel command control layer that processes channel commands and controls cache and data transfer operations. It is located in the CHA. CHA Prog. is recognized by the logical volume number and logical block number.
<b>CHA PCB (CHannel Adapter PaCkage Board)</b>	A PCB used to connect to the host processor. There are two types of CHA PCBs, one for optical channels and the other for metal channels. The CHA PCB for optical channels is provided with the LCM in its optical link control unit.
<b>CHP</b>	channel processor or channel path
<b>CHIP</b>	Client-Host Interface Processor
<b>CHPID</b>	channel path identifier
<b>CKD</b>	count key data
<b>CL</b>	cluster
<b>CM (Cache Memory)</b>	See <b>cache</b> .
<b>COLD</b>	Status that the battery is off.
<b>CPM</b>	Short for Cache Port Master. (Part of the cluster for mounting the Cache Box. It is possible to mount more than 6 GB of Cache memory.)
<b>CPS</b>	Short for Cache Port Slave. (Part of the cluster for mounting the Cache Box. It is possible to mount more than 6 GB of Cache memory.)
<b>CPU</b>	central processing unit
<b>CSA</b>	Canadian Standards Association
<b>CT</b>	Continuous Track maintenance support application
<b>CU</b>	control unit
<b>CVS</b>	custom volume size (also called VSC: Volume Size Configurator)
<b>DASD</b>	direct access storage device

<b>DCR</b>	dynamic cache residency (also called Cache LUN XP)
<b>DE</b>	Data Exchange software
<b>DFDSS</b>	Data Facility Dataset Services
<b>DFSMS</b>	Data Facility System Managed Storage
<b>DFW</b>	DASD fast write
<b>Disruptive</b>	Status that there is no I/O from the host (off-line).
<b>DKA (DisK Adapter)</b>	Provides the control functions for data transfer between drives and cache. The DKA contains DRR (Data Recover and Reconstruct), a parity generator circuit. It supports four SCSI buses and offers 64 KB of buffer for each SCSI bus. The DKA also has an internal processor.
<b>DMA0</b>	Controls the data transfer between the ADP and cache.
<b>DMA1</b>	Controls data transfer between the buffers in the DKA and cache.
<b>DMA2</b>	Controls data transfer between the buffers in the DKA and drives.
<b>DMP (Disk Master Program)</b>	A RAID control layer that provides cache control, logical-to-physical address translation, and RAID control functions. DMP is located in the DKA. DMP is recognized by the logical volume number and logical blocked number.
<b>dr</b>	drive
<b>DRIVE</b>	Represents a SCSI drive whose internal data format is FBA (fixed length).
<b>DSF</b>	Device Support Facilities
<b>DSP (Disk Slave Program)</b>	A SCSI drive control layer that provides SCSI control, drive data transfer control, and parity control functions. It is located in the DKA. DSP is recognized by the physical volume number and LBA number.
<b>DW</b>	duplex write
<b>DWL</b>	duplex write line
<b>ECKD</b>	Extended Count Key Data
<b>EOF</b>	end of field

<b>EPO</b>	emergency power-off
<b>EREP</b>	error reporting
<b>ESA</b>	Enterprise Systems Architecture
<b>ESCON</b>	Enterprise System Connection (IBM trademark for optical channels)
<b>ExSA</b>	Extended Serial Adapter
<b>FAL</b>	File Access Library (part of the Data Exchange software)
<b>FC</b>	Fibre Channel
<b>FC-AL</b>	Fibre Channel arbitrated loop
<b>FCC</b>	Federal Communications Commission
<b>FCU</b>	File Conversion Utility (part of the Data Exchange software)
<b>FDR</b>	fast dump/restore
<b>ft</b>	foot/feet
<b>F/M</b>	format/message
<b>FBA</b>	fixed-block architecture
<b>FWD</b>	fast-wide differential
<b>FBUS (Fast I/O BUS)</b>	Carries the data that is transferred between the adapter and cache. It is duplexed using two physical buses (H and L sides), each of which provides a data transfer rate of 200 MB per second. The L side bus is also used to access shared memory during interprocessor communication.
<b>FM (Flush Memory)</b>	Each microprocessor has FM. FM is nonvolatile memory that contains microcodes.
<b>FPC (Failure Parts Code)</b>	Refer to the ACC section.
<b>GB</b>	gigabytes
<b>GLM</b>	gigabyte link module
<b>GUI</b>	graphical user interface

<b>HCD</b>	hardware configuration definition
<b>HOT</b>	Status that the battery is on.
<b>HP</b>	Hewlett-Packard Company
<b>H/W</b>	hardware
<b>Hz</b>	Hertz
<b>ICKDSF</b>	A DSF command used to perform media maintenance
<b>IDCAMS</b>	access method services (a component of Data Facility Product)
<b>IML</b>	initial microprogram load
<b>in.</b>	inches
<b>I/O</b>	input/output (operation or device)
<b>IOCP</b>	input/output configuration program
<b>JCL</b>	job control language
<b>KB</b>	kilobyte
<b>kcal</b>	kilocalorie
<b>kg</b>	kilogram
<b>km</b>	kilometer
<b>kVA</b>	kilovolt-ampere
<b>kW</b>	kilowatt
<b>LAN</b>	local area network
<b>lb</b>	pound
<b>LCM (Link Control Module)</b>	Provides link control functions such as conversion of formats between optical and metal channel interfaces. The LCM contains an internal processor (LCP) and 2 KB of buffer memory.
<b>LCP (Link Control Processor)</b>	Controls the optical links. LCP is identical to that used in the DKC90. LCP is located in the LCM.

<b>LCP</b>	link control processor, local control port
<b>LD</b>	logical device
<b>LDEV</b>	logical device
<b>LED</b>	light emitting diode
<b>LIVE INS</b>	Short for Live Insertion, it is the signal cable for detecting hot-plugging.
<b>LM (local memory)</b>	Each microprocessor has LM.
<b>LPAR</b>	logical partition
<b>LRU</b>	least recently used
<b>LUN</b>	logical unit, logical unit number
<b>LUSE</b>	Logical Unit Size Expansion
<b>LVI</b>	logical volume image
<b>LVM</b>	Logical Volume Manager
<b>m</b>	meters
<b>main task</b>	Consists of the control tasks of this subsystem (CHA Prog., DMP, DSP) and the SC kernel tasks that supervise the DKC control tasks. They switch the control tasks by making use of the task switching facility of the SC kernel.
<b>MB</b>	megabytes
<b>MBUS (Multi CPU BUS)</b>	Used to support interprocessor communication between the CHA Prog., DMPs, DSPs, and shared memory.
<b>MFC (Main Failure Code)</b>	Refer to the ACC section.
<b>mm</b>	millimeters
<b>MP</b>	microprocessor
<b>MPLF</b>	Multi-Path Locking Facility
<b>MR</b>	magnetoresistive



<b>ms, msec</b>	milliseconds
<b>MVS</b>	Multiple Virtual Storage (including MVS/370, MVS/ESA, MVS/XA)
<b>nondisruptive</b>	Status that there are some I/Os from the host (online).
<b>NVS</b>	nonvolatile storage
<b>OEM</b>	original equipment manufacturer
<b>OFC</b>	open fibre control
<b>OLM</b>	optical link module
<b>ORM</b>	online read margin
<b>OS</b>	operating system
<b>P/DAS</b>	PPRC/dynamic address switching
<b>PC</b>	personal computer
<b>PCI</b>	power control interface
<b>PM</b>	Performance Manager software
<b>P-P</b>	point-to-point
<b>PPRC</b>	Peer-to-Peer Remote Copy
<b>PS</b>	power supply
<b>R&amp;S</b>	Russel & Stoll
<b>RAID</b>	redundant array of independent disks
<b>RAM</b>	random access memory
<b>Real Time OS</b>	A basic OS for controlling the RISC processor. Its primary tasks are to control and switch between the main tasks and SVP communication tasks.
<b>RC</b>	reference code
<b>RC</b>	Remote Control software
<b>RCHA</b>	Short for RAID Channel Adapter, it is the name of an LSI in the CHA.

<b>RISC</b>	reduced instruction set computer
<b>R-SIM</b>	remote service information message
<b>R/W</b>	read/write
<b>S/390</b>	IBM System/390 architecture
<b>SAM</b>	system administration manager
<b>SBC (Sub BUS)</b>	A data bus in the DKA.
<b>SCA (SCSI Adapter)</b>	Controls SCSI packets.
<b>SCSI</b>	small computer system interface
<b>sec</b>	second
<b>seq.</b>	sequential
<b>Shared memory</b>	Stores the shared information about the subsystem and the cache control information (director names). This type of information is used for the exclusive control of the subsystem. Like cache, shared memory is controlled as two areas of memory and fully nonvolatile (sustained for approximately 96 hours).
<b>SIM</b>	service information message
<b>SMS</b>	System Managed Storage
<b>SNMP</b>	simple network management protocol
<b>SSID</b>	storage subsystem identification
<b>SVP</b>	service processor
<b>SM (shared memory)</b>	See <b>shared memory</b> .
<b>SMP</b>	shared memory port
<b>SPC (SCSI Protocol Controller)</b>	A SCSI initiator that controls the SCSI devices.
<b>SVP communication tasks</b>	Controls the communication with the SVP.

<b>TB</b>	terabyte
<b>TID</b>	target ID
<b>TPF</b>	Transaction Processing Facility
<b>TSO</b>	Time Sharing Option (an IBM System/370 operating system option)
<b>UCB</b>	unit control block
<b>UL</b>	Underwriters' Laboratories
<b>VDE</b>	Verband Deutscher Elektrotechniker
<b>VM</b>	Virtual Machine (an IBM S/390 system control program)
<b>VOLID</b>	volume ID
<b>volser</b>	volume serial number
<b>VSC</b>	Volume Size Configurator (also called CVS: Custom Volume Size)
<b>VSE</b>	Virtual Storage Extension (an IBM S/390 operating system)
<b>VTOC</b>	volume table of contents
<b>XA</b>	System/370 Extended Architecture
<b>XDF</b>	Extended Distance Feature (for ExSA channels)
<b>XRC</b>	Extended Remote Copy



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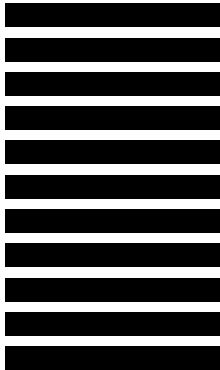
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